DOCUMENT RESUME

ED 051 376 VT 012 749

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TITLE	CPM (Critical Path Method) as a Curriculum Tool.
INSTITUTION	State Univ. of New York, Buffalo. Coll. at Buffalo.
PUB DATE	Feb 71
NOTE	12p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	*Critical Path Method, *Curriculum Development, *Curriculum Planning, Educational Needs, *Industrial Arts, Methods, Research Needs, *Vocational Education

ABSTRACT

This document discusses and illustrates the use of the Critical Path Method (CPM) as a tool for developing curriculum. In so doing a brief review of the evolution of CPM as a management tool developed by E. I. duPont de Nemours Company is presented. It is also noted that CPM is only a method of sequencing learning activities and not an end unto itself. (JS)

ED051376

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CPM AS A CURRICULUM TOOL

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February, 1971

VT012749

THE MANUFACTURING ENTERPRISE: CRITICAL PATH METHOD

A montage of new-type industrial arts programs have emerged in the last few years. Projects such as the Industrial Arts Curriculum Project, American Industry Project, and Industriology Project have included manufacturing of products in their secondary school curriculum. Many leaders like Olson, Maley, DeVore, Mitchell, and Yoho have advocated including a form of production in their curricular approaches. (Decker and Bohn, 1968)

The manufacturing enterprise represents a cohesion of the many approaches developed by the preceding leaders and projects. More specifically, the course implemented at the Campus School of Buffalo State University College has been developed to include those industries which utilize a corporate structure, design competitive products, and produce those products for marketing in the technological society. Within the manufacturing enterprise, the financing, planning, scheduling, controlling, processing, fabricating and marketing of products are studied.

The Critical Path Method (CPM) was utilized in order to provide a visual means of sequencing or scheduling of specific

learning activities or tasks for the students. For an explanation of the adaptation of CPM in the manufacturing enterprise, the curriculum tool is presented as follows: (a) Evolution of CPM, (b) Analysis and Implementation, and (c) Evaluation.

Evolution of CPM

The Critical Path Method was developed by an operations research group financed by the E. I. duPont de Nemous Company in 1956. By 1960, many construction companies had begun to adopt this new management tool. About the same time, problems evolved in the development of the Navy's Polaris Missile Project (Fleet Ballistic Missile Program). Program Evaluation and Review Technique (PERT) was developed to co-ordinate the contract work of over 3000 companies on the Polaris.

In analyzing and comparing the planning and control systems of CPM and PERT, it should be noted that the graphic presentation of the industrial activities are very similar. However, a significant difference occurs in the estimating the time scheduling of activities. Mathematically, PERT is more concerned with the statistical probability of the completion of the industrial activity; whereas, CPM, in the construction industry, is based upon past experiences or activities which can be estimated with a reasonable degree of accuracy. (United States Army Ordnance Corps, 1963; Radcliffe, 1967)

Analysis and Implementation

To utilize CPM, the curriculum worker should first develop a rationale for the course or program whether the course be traditional or innovative in nature. The educator should then develop a comprehensive set of behavioral objectives or learning tasks which the learner should accomplish in either the unit of study or during the semester.

Numerous terms are usually associated with CPM. For the purposes of this presentation, only a few of the more pertinent terms are defined. They are as follows:

Activity - A learning task which pupils are expected to accomplish in a given length of time.

Early Start Time - The earliest time an activity or learning task can be begun by the learners.

Float - The time available to complete the learning task; difference between early finish time and late finish time.

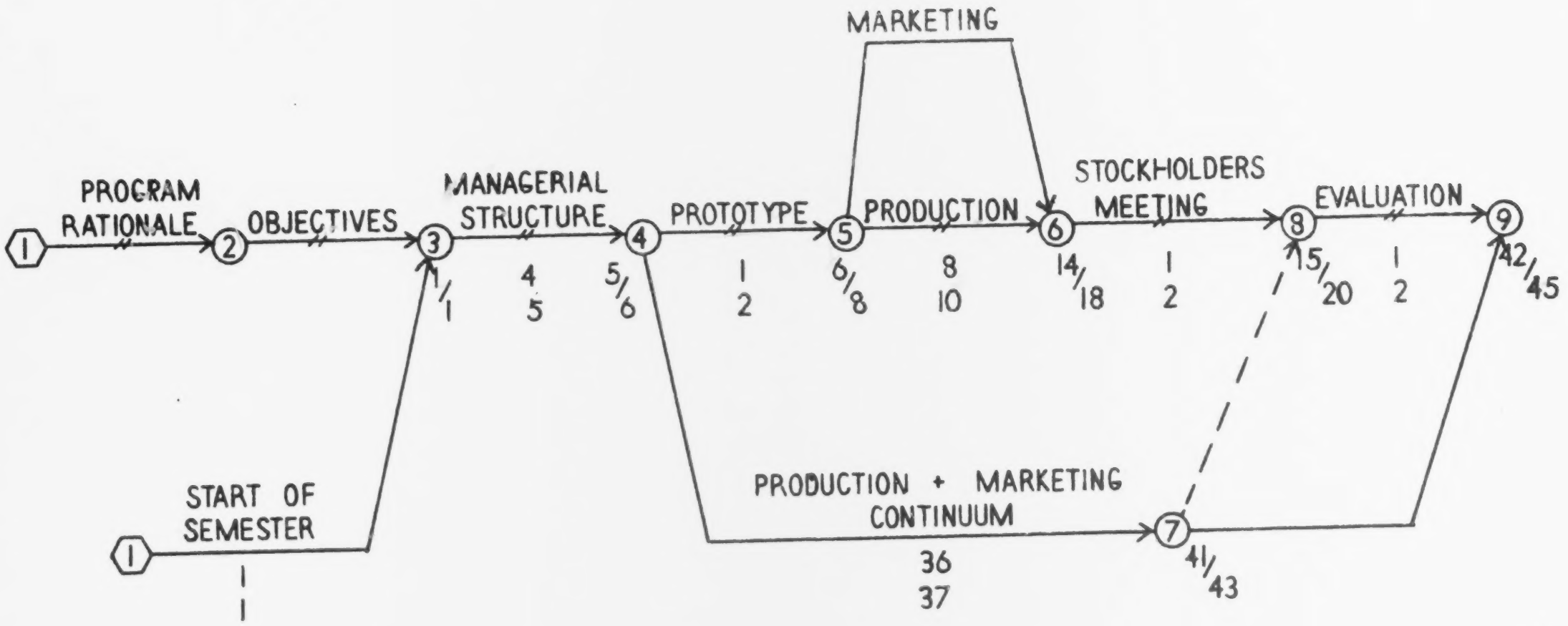
Late Finish Time - The maximum time in which the learning task should be accomplished by the learners.

Monitoring - The means used by the educator in evaluating the accomplished learning tasks within the computed time intervals.

Node - A circle which represents the beginning or end of the learning task. (Radcliffe 1967)

The graphic representation of the manufacturing enterprise system in Figure I serves as the system structure for more elaborate network of learning activities. For example, production elements are scheduled and sequenced for presentation in the production and marketing continuum in Nodes 4 - 9.

FIGURE 1


MARKETING
PROGRAM RATIONALE
OBJECTIVES
MANAGERIAL STRUCTURE
PROTOTYPE
PRODUCTION
STOCKHOLDERS MEETING
EVALUATION
1
2
3
4
5
6
7
8
9
1/1
4/5
5/6
1/2
6/8
8/10
14/18
1/2
15/20
1/2
42/45
START OF SEMESTER
1
1
PRODUCTION + MARKETING CONTINUUM
36
37
41/43

In order to clarify several questions which might have arisen in examining Figure I, a brief description of several of the Nodes is as follows:

Figure II

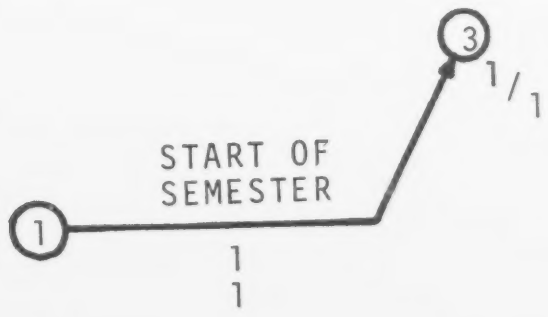


Figure II represents the first day of the new semester. The numbers $\frac{1}{1}$ between Nodes 1 and 3 refer to the early start time and the late finish time. Below Node 3, the numbers 1/1 are the cumulative times in days or periods. The manufacturing enterprise approach is designed for 7th and 8th graders for one semester. The semester consists of 45 days in which each class meets for a period of 40 minutes.

Figure III

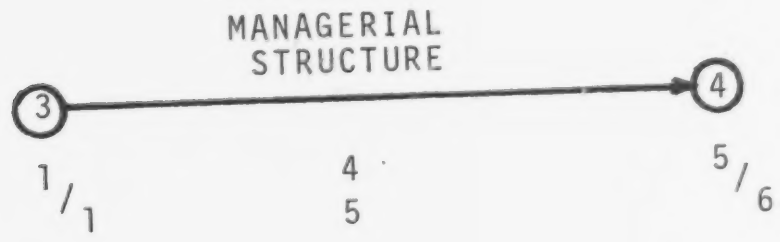


Figure III represents the managerial structure of a corporation in which the class stockholders serve as the Board

of Directors who elect the President, Vice-President, and Secretary-Treasurer. The numbers $\frac{4}{5}$ pertain to the number of days or periods needed to implement the organization structure of the enterprise. The 4 above refers to a minimum of four days or periods needed to complete the learning activity. The 5 below pertains to the maximum number of periods needed by the students to complete the activity. The number 5/6 represents the cumulative time spent on the activities from Node 1 thru 5.

Figure IV

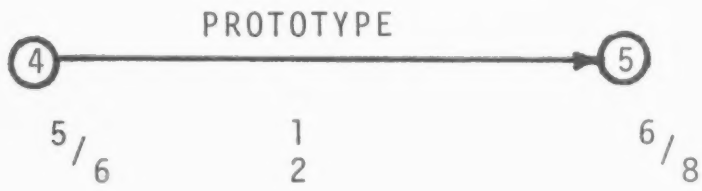


Figure IV refers to the student's selection of a product such as desk name plate holder, plastic coin purse, plastic ball, or serving tray. Since the first product produced has been developed and mass produced by students in previous classes, the majority of the jig and fixture design have been completed along with the flow process charts. The number $\frac{1}{2}$ represents the minimum and maximum time needed by the students to select their product. Again, the number below Node 5 of 6/8 is computed by adding 5/6 and $\frac{1}{2}$ together.

Figure V

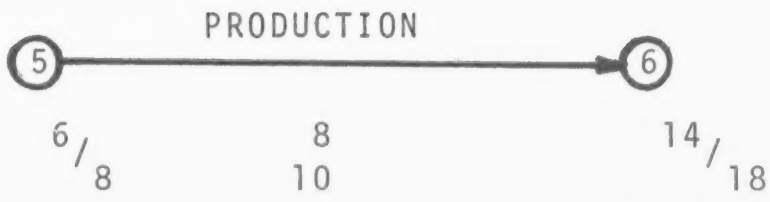


Figure V refers to the actual production of the item with the time allocated ranging from 8 days to 10 days or periods.

Figure VI

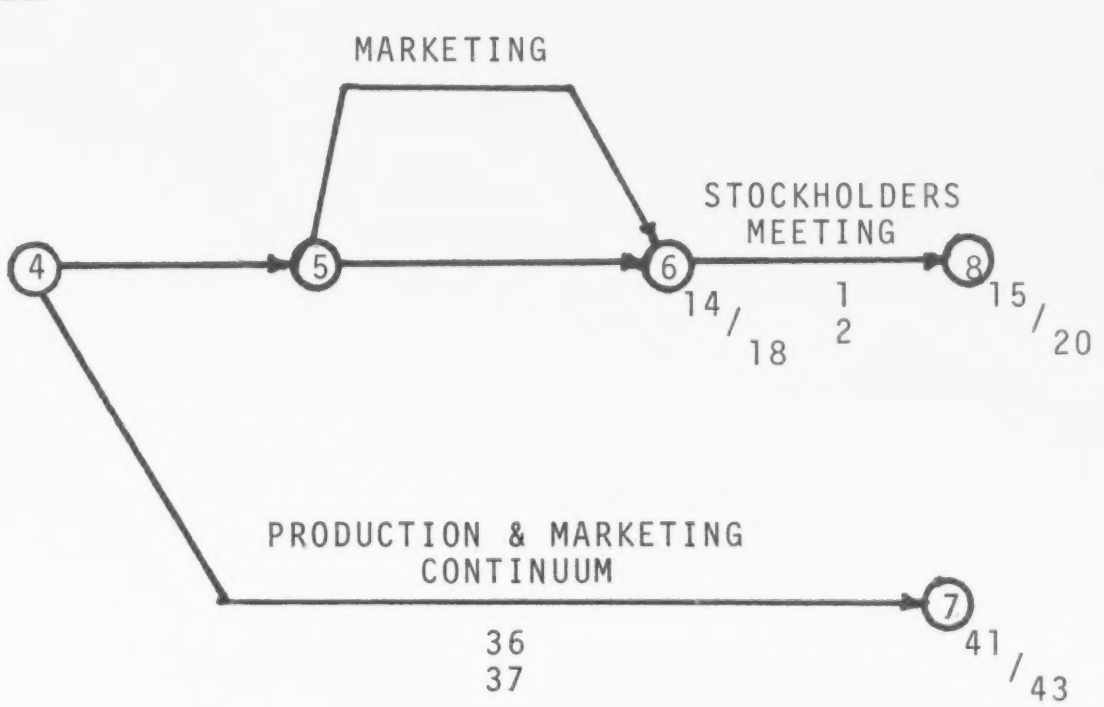


Figure VI is a series of parallel activities which occur simultaneously with the production of the first product. Marketing activities, such as advertising and placing of orders,

are focused upon by only a few members of the class. The production and marketing continuum (Nodes 4 - 7) is a perpetual activity in which small groups of students design and build a prototype of another product. At least one developed product is chosen by the students for production.

A minimum of two stockholders meetings are scheduled during the semester. During the first formal meeting (Nodes 6-8), the officers report on their activities and a new product is selected for production.

Evaluation Design

Industrial arts, as well as other secondary school curriculum areas, typically neglect to evaluate their programs in terms of task or behaviorial objectives advocated by Bloom, 1956 of Mager, 1962. An example of one of the objectives in the manufactruing enterprise that was designed for the seventh and eighth grade students is as follows:

> Each student should be able to identify and briefly describe in a short paragraph the three basic types of ownership. (Proprietorship, Partnership, and Corporation)

The behavioral objectives may be monitored during the course of the semester by administering quizes and by obtaining feedback from student discussion groups. The final assessment of the behavioral objectives was analyzed through information

obtained from an objective test given at the start (Pre-test) and at the end (Post-test) of the semester. The behavioral examination was primarily concerned with Bloom's cognitive (mental) domain.

In the future, additional instruments must be designed to measure the psychomotor (physical) and affective (social-emotional) domain of the students. (Bloom, 1956) In the affective domain, a modification of the American Industry Project's Evaluation Instrument dealing with the student's attitude toward industry could be incorporated in the basic research design. (Nelson, 1968) Feedback from the community, parents, teachers, administrative staff and students must also be a part of the evaluation.

Little is anything has been said about methodology used to present the implosion of technical information the instructor is confronted with in analyzing the area of manufacturing. Therefore, <u>CPM is not the message but only the management tool or medium used in sequencing relevant learning activities.</u>

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